**Notes – MAGIC partners meeting**

**Dec 8, 2020 (online)**

Resources available here: <http://www.magic-air.uk/partners-meeting-dec-2020.html>

Meeting recording: <https://us02web.zoom.us/rec/share/tWIrXBT_DkhRI-QmEiT8x_Mk92jgXy-h-F3NiE2DrccsehxlYy0RJxvBEL5eCRP9.-VPTYdbcemaaT4YN> Passcode: A2p.v7XJ

Intro:

* Delay in meeting due to pandemic
* Our work focus changed somewhat over this time, but the work done on ventilation still relevant to broader MAGIC goals
* We hope now to get back on track
* Look forward to hearing your input on our proposed programme

***MAGIC Updates:***

*Clemence le Cornec - LSBU Traffic Study [please see presentation here]*

* LSBU Traffic study 2019
* Traffic light change, agreed with TfL
* Longer cycle: traffic intervention has an impact on very local air quality
* Part of the emissions are moved slightly upstream from junction
* Meteorological conditions had a significant impact
* In terms of pedestrian exposure, hard to say as pedestrians have to wait longer to cross with the longer cycle.

**Questions/Discussion:**

* Difficult to say if these types of interventions where traffic light signal timings are altered are worth exploring. The difference does depend a lot on meteorological conditions, and we need a better understanding of this to understand
* For the traffic study, it will take a while to get results for personal exposure. It is taking some time to finalise the algorithm for tracking the vehicles. We hope to have a full 3D map of personal exposure. Low cost sensors up and down the street may also give us an idea of this, without running the full Fluidity model

*Rajesh Bhagat - Ventilation Experiments [please see presentation here]*

* Driven by Covid have done a number of experiments around ventilation inside e.g. train carriage, how does pollution moves around a space
* Directly relevant to our ongoing work with MAGIC

**Questions/Discussion:**

* Is the train a moving train condition? Is it a moving carriage. This is a steady case. Even in moving carriage driven by mechanical ventilation. The experiment is an intercity train with no opening, totally mechanically ventilated.
* What were the main conclusions from the train carriage study? Recommendations for passengers or designers of ventilation systems? Very initial study. This simple model does not capture dynamics in centre. In the middle if we keep some space empty it gives a better outcome. Also, increase the ventilation rate. Six people in carriage ghzg normally tkes 88, and CO2 levels already x3 ambient. Surprisingly high numbers.

*Janet Barlow - Lidar study [please see presentation here]*

* Work using the Doppler Lidar looking at wind profiles around the LSBU test site and examining the wakes of tall buildings

**Questions/Discussion**

* Practitioners often have to model wakes for tall buildings when they are in the design process - do any of the commercial\CFD codes used compare with Janet’s actual measurements? Janet is not aware yet whether these measurements compare with commercial/CFD codes for modeling the wakes of tall buildings. She is happy to make the data available to see how it compares. There are two key things to think about: What the simulation simulates and also what you feed in as inlet conditions to those simulations. That’s something Janet and Huw are looking at presently, and they should be able to give some practical guidance on this topic in due course.

*Laetitia Mottet - Geometry generation and data assimilation [please see presentation here]*

* Ex

**Questions/Discussion:**

* To work out how well the simulations are working, we use sensor data and compare mean square error. We do use the same data to feed into the model but there is a condition in the data assimilation that means that the results of the model are not perturbed. Rosella Arcucci can provide more information on this.

*Fangxin Fang: Physics modelling inside Fluidity [please see presentation here]*

* We have been working on how physics should be modelled, in the outdoor environment
* Trees, heat transport, etc.
* The presentation shows the results of our work

**Questions/Discussion:**

* Validating model performance with and without trees. Then, once you look into the concentrations will you be able to look at how much of the PM gets absorbed by leaves. First, we validate the model by comparing it with published results, that is for a simple case. For a more complex and realistic case can't validate at present as no data. Suggestions are to look into validation using wind tunnel (Audrey has some suggestions on who is doing this, and also <https://www.ifh.kit.edu/1526.php> Christof Gromke). Also, Paul has some data from Cambridge where they took measurements of characteristic differences for road and grassland temperatures,
* The team’s work will also be able to look at how much PM gets absorbed by leaves.
* Martijn’s group has done similar work, they also did the South Kensington case so interesting to compare results. One of difficulties they had is that in a radiatively driven simulation, to get a good convective boundary layer they needed to have a very deep domain. The two groups will compare notes on how they approached this, and their simulations in general
* Suggested that it is worth validating the temperature-related tree data, as its unclear how the tree can be responding so quickly to temperature. Good to validate for increased confidence.

*Catriona Brady, World Green Building Council - Air Quality in the Built Environment [please see presentation here]*

* World Green Building Council is hub for all the world’s green building councils locally
* Air pollution sits within ‘health and well-being’ in their work, and a new framework just launched to cover this
* Scope has been expanded - from people in the community, right through the supply chain etc.
* Air quality is the number one topic flagged across all local offices, among the health and wellbeing challenges. Both indoor and outdoor.
* They have a partnership with Climate and Clean air Coalition to set up a campaign on air quality in the built environment.
* Four aims of campaign: reduce contribution across the lifecycle of built environment, mitigation of indoor air pollution sources, promote sustainable building operation,
* BUT - cannot change what we can't measure
* Partnership with Reset - to start a global air quality monitoring campaign to put sensors in buildings across the world. Pilot projects now up and running. Monitor and share on a public platform, indoor and outdoor air.
* Pandemic has had an impact as often people are not in offices etc.
* Local GBC offices are linked to over 40 certification standards for buildings. Talking about linked credits to these from the sensor campaign.
* Focus on disadvantaged buildings, particularly schools, with a buy one donate one campaign on sensors.

*Tim Sharpe, University of Strathclyde - Building Tight, Ventilating Right? [please see presentation here]*

* Focus on peoples’ homes
* Driving up thermal standard has been a key driver. Air tightness has become a way to achieve this
* Smaller, more airtight buildings. So difficult balancing act with ventilation and air quality
* Ventilation is critical, impacts for health and energy use
* But work shows we are currently not achieving good standards of ventilation
* E.g. Asked people how they use their homes. People don’t use their trickle vents. Only open windows to regulate temperature. Not about ventilation, people not making decisions related to air quality.
* Bedrooms were often over 1000ppm CO2 at night.
* Could solution be mechanical? Gives both heat and ventilation?
* Studied mehanicmal v natural ventilation. The mechanically ventilated do perform better in terms of ventilation. However, when you look at flow rates, not really doing what they should. Impact on energy efficiency also.
* Also looked at homes in london with mechanical systems. Not great. Poor design intentions. Ducts badly installed, missing vents, noise was a particular issue, Filters were getting clogged up, lack of maintenance.
* Decentralised mech extract ventilation - constantly running extract fan in kitchen or bathroom, another option. Very complex parts so often it shortcuts. People turn them off due to noise.
* Ventilation and health. Looked at this in relation to Covid. Homes are a significant problem, where most people catch Covid.
* When took results to building standards - no direct causal link between low levels of ventilation and health, so hard to push for action.
* Design decisions driven by compliance.
* Everything is fragmented, noone has an overview of the process. No good tools to predict performance.
* Need better tools to predict performance, better standards, and better compliance with standards (testing in real life post completion).

*Phil Stopford, ANSYS - ANSYS Solutions for the Built Environment [please see presentation here]*

* ANSYS are a bridge between the MAGIC type research and what their customers, industrial design, are looking to do.
* Software on Fluids, Structures, Optical etc.
* They sell software to a range of building industry companies and construction, design architecture.
* Fluids a small part but not the biggest part, and the built environment is a small part of the Fluids business.
* In terms of getting the kind of work we do in MAGIC implemented into the ANSYS software, this would take a lot of collaboration from a range of built environment stakeholders.
* Multi-physics is where engineering software is going. Look at the flow, the structural design, impact on fire risk etc. Then it becomes a way of collaborating across different types of engineering. Have a model like a digital twin of the construction, a way of assuring the building is performing in the way it is supposed to do
* High performance computing another trend. LES. Higher order simulation. Look at more complicated issues. Using computer power for early design work to eradicate problems before they occur.
* At the moment they have a lot of emphasis on performance of the models. Mesh quickly. High quality structure and unstructured. On the physics side, emphasis on speed and stability.
* Future bright in terms of what can be done. More and more detail in models
* Most people at the moment use RANS models, rather than full LES. Some scepticism that LES will give a big improvement. People can’t afford it, don’t understand it, and you can get some very wrong answers. These are big challenges.
* Largest model is 400+ building model in New York, after the collapse of WTC. 2m mesh resolution on the buildings. Moving mesh to look at collapse of the towers. Not very well validated, qualitative in approach. This used RANS model.
* Recent developments -
  + scale resolving turbulence model. Scale adaptive simulation - switches between RANS and LES. Series of hybrid models.
  + Can also look at tunable parameters within RANS. Saves cost of LES.
  + Realtime LES simulation using data assimilation. Reducing CFD calculations to seconds.
* Driven by what customers require. Built environment adoption of LES has been slow. RANS is still the best option for most people. Still needs expert use.
* Practical cost efficient models are what is needed.
* Great potential for developments in this area, look forward to what you can contribute from your project.

**Questions/Discussion:**

* Using mesh adaptive technologies. Is that something they are developing? They provide a general moving mesh capability. Based on gradients, sometimes the curvature. Plus the LES resolution index. Start with RANS mesh and have the code automatically modify the mesh to describe an adequate resolution for LES. Rather new. To be in the next release. Interest to share ideas on this with Chris and the Fluidity team.
* Don’t see any limit to how large calculations can be in principle. But that is being used more in the aerospace industry, rather than the built environment. Really have to make the case to convince the companies to do simulations of that size.

*Audrey de Nazelle, Imperial College London [please see presentation here]*

* What are the interventions that can be made to have a positive impact on personal exposure in microscale built environment?
* Microcale exposures (of the type modelled in Fluidity) could be relevant health-wise.
* Measurement studies have been carried out to look at this
  + E.g. in Barcelona, people in cars had the highest exposure rate. But once normalized (inhalation rates, time spent etc.) people biking and walking modelled to have greater exposure over 24-hours
  + Measured exposure data shows transportation microenvironments found to account for a substantial proportion of peoples’ intake of pollution (black carbon).
* So, types of microenvironment matter. But is this relevant health wise?
* More tricky question. Not much epidemiological evidence.
* Epieimiologidal studies based on assumption that peole spend their whole lives right in front of their house.
* To understand exposures related to different travel modes - we have tried to adapt them for changes in concentration AND change in exposure during shift in travel mode.
* MAGIC - differences in exposures from different travel modes will largely be due to proximity to traffic itself. Might make sense to look at the impact of e.g. where you sit when you wait for your bus. The types of impact that trees will have. You may find a different health impact assessment for different options.

**General questions/discussion:**

* It’s coming through that the general population often doesn't understand that air is polluted and they don’t know how ventilation works in buildings. The airflow associated with ventilation is often tiny, hard to perceive. There is an educational process across the disciplines that needs to take place.
* Work of Catriona to make air quality more ‘visible’ is essential. Complex to do that as just providing the resources/equipment is not sufficient. Monitors often don’t perform as you are expecting them to.
* In Catriona’s project, there was a long participant manual for the monitors, but there is a need to balance between data quality and usability. Technical partners RESET do monitor testing. If those taking part are not using Grade A or B monitors they can still be part of the campaign, but it goes in as Grade C data.
* Re. CO2 measurement used in Tim’s studies- CO2 keeps bad company. In and of itself not a problem. But it is indicative of other things going on. This is one of the big plus points that it is now cheaper and easier to measure pollutants.
* CO2 also a good marker of exhalation in relation to Covid.
* New build housing in Scotland now needs to have a CO2 sensor in the bedroom. .

*Paul Linden - final 12-months [please see presentation here]*

* 4-main thrusts over the next year to meet vision
  + Continue the validation of Fluidity. For new aspects developed.
  + Continue analysing the LSBU test site (longer term studies earlier on and this is also part of the validation for Fluidity)
  + London Road traffic and emissions study
  + Optimisation - cost benefit, placing of sensors etc.

**Breakout Groups**

*Any questions on what we propose to cover in the work packages?*

Group 1

* - who is going to do the cost-benefit model?

Group 2

* It’s clear.
* Impressed with all the thermal/heat island things going into Fluidity now. Was an original objective and good to see it coming through now.

Group 3

* Gaussian models can produce annual averages, whereas CFD work can't produce the same results.
* CFD can give you a number of discrete cases.
* The question is, can we cover within MAGIC some models which also help with compliance.
* MAGIC plan to produce a faster tool which can run on a laptop, but it would be better to produce a database on an open access website to host the monitored data which has been collected in the project.

*Which areas are missing?*

Group 2

* Correct validation will be essential
* Electric cars will start to pop up. This may have a result on accumulation of pollution over time. A modal-shift like this should be considered.
* To develop the physics in Fluidity we need to consider the atmospheric science in more detail
* Original proposal had the intention to produce a tool. A rule of thumb tool would be useful. A more comprehensive tool could be something for Phase 2.

Group 3

* what can we say in particular about the impact of different interventions on air quality in cities

*Where could MAGIC go next?*

Group 1

* Continue along same lines, more field studies like Sep 2019 study to cover more junctions to have more data to enable more generalised comments
* Do traffic models work well enough to estimate magnitude of change? How well do our models compare to reality?
* Easy to use dispersion model to use with traffic models?
* Pedestrian exposure and health impacts built into models
* Indoor – outdoor coupling model
* Forecasting model
* Easy to use models that could be used by TfL e.g.

Group 2

* Develop the work on thermal effects
* Comprehensive tool/suite of tools

Group 3

* how do we use the information we can extract from the models developed? It seems to be that we have had a snapshot of how remote working might exist in a future city. Should this be the direction for a future MAGIC project?
* make more firm recommendations. It's very well to say the model shows this, but what will have impact is stating a recommendation for the real world.

what would be the impact of future modal shifts in commuting and local area transport in cities?

* MAGIC 2.0 should be thinking about the psychology of the change. How greener cities could help mental health as well as improve air quality.

*How would you like to see our final work presented/packaged?*

Group 1

* A synthesis document would be useful to understand how different parts fit together (from academic perspective) – consider it as coherent piece of work
* Final document: Everything we learned so far within MAGIC (also include difficulties, what has worked well, what have you learned from working on such a large project, include 1 page “executive summary” for partners).

Group 2

* An online tool could be useful, or a synthesis report

Group 3

* online database of the information collected via the various trials.
* giving someone data can be presenting them with an impossible task, so setting out conclusions in a document would be a more useful deliverable - in language anyone can pick up.
* I think videos and visualisation could be very powerful in engaging and communicating with people.
* green space is important, but changing the urban design by getting rid of parked cars as well as moving cars.

*How can we make findings useful for non academic partners?*

Group 1

* TfL is interested in a simple tool, straightforward answers to effect of signal timings, pedestrian / cycling exposure.
* An understanding of the magnitude of impacts of different interventions would be useful

Group 2

* Simple tool showing rules of thumb, standards and best practices would be useful. Web based tool could work
* Needs to be easy to use. More qualitative, not fully quantitative, for example. Generic building typologies or street typologies.
* Design guidance
* Highlight critical gaps - what should be done and what is done in industry. Communicate those to developers/general public and lawmakers.

Group 3

* communication has to be a key focus of pulling together MAGIC. And should be a key focus of any MAGIC 2.0, if that gets funded.
* final report should try to attract planners and urban designers to test whether the tall building planning approval policies are working.

*Is a final workshop/conference a good idea and what format?*

Group 1

* Similar to today might be really useful
* Celebration of project end

Group 2

* Enough speakers from MAGIC and MAGIC Circle to support an entire conference
* To engage industry a conference is helpful, or you can or directly visit the companies.
* Workshops could work e.g. to show how a tool works in practise.
* Tailor different events to different types of stakeholders.
* Conference should be international.

Group 3

* Yes (in person best with some virtual element)
* keep it virtual
* two days better than one day